

Attorney Docket No.: 17714 (AT 20958-1007)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: George Jyh-Shann Chou

Art Unit: 1742

Serial No.: 10/073,488

Examiner: Wyszomierski, George P.

Filed: February 11, 2002

Title: METHOD AND APPARATUS FOR
INDUCTION HEAT TREATING
ELECTRICAL CONTACTS

DECLARATION UNDER 37 1.132

Mail Stop: AF
P.O. Box 1450
Commissioner for Patents
Alexandria, VA 22313-1450

I, Dean Small, declare and state as follows:

1. I have reviewed and understand the specification and drawings of U.S. Application 10/073,488 (hereafter "Subject Application").
2. I have reviewed and understand the claims of the Subject Application (hereafter "Claimed Invention").
3. I am currently a registered patent attorney and have represented Tyco Electronics as outside patent counsel since at least 2001.

FACTS AND DOCUMENTARY EVIDENCE

4. Factual evidence proving the statements made in this Declaration can be found hereafter and in the attached documents (Appendices A-C).
5. Appendix A attached hereto sets for a preliminary invention disclosure prepared by the inventors of the Subject Application and assigned PID number 2001153 (hereafter "PID 2001153"). The PID 2001153 describes the Claimed Invention in detail, and includes numerous computer generated drawings illustrating embodiments of the Claimed Invention.
6. On information and belief, the drawings attached to PID 2001153 at appendix A were prepared by the inventors on or about June 28, 2001, which is the date printed on the PID 2001153. On information and belief, the written description in the PID 2001153

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at appendix A was prepared by one or more of the inventors on or about June 28, 2001, the date on the cover page of the PID 2001153. The PID 2001153 is signed and dated by each inventor on June 29, 2001.

7. On information and belief, the PID 2001153 was submitted by the inventors to the responsible in-house patent counsel, Michael Aronoff, who was employed by Tyco Electronics.

8. On information and belief, Mr. Aronoff reviewed the PID 2001153 and determined that a patent application should be prepared in connection with the PID 2001153.

9. On or about October 29, 2001, Mr. Aronoff sent the PID 2001153 to me, along with a cover letter dated October 29, 2001 which is attached at Appendix B, requesting that I prepare a patent application related to the inventions described in the PID 2001153.

10. In accordance with the request of Mr. Aronoff, during the weeks following October 29, 2001, I undertook to contact the first named inventor, and began to work with the inventors to prepare a first draft of a patent application.

11. On or about December 20, 2001, I provided to Mr. Chou an electronic copy of a first draft of a patent application related to the PID 2001153, and requested that he and his co-inventor review the application. A copy of my cover letter dated December 20, 2001 to Mr. Chou is attached at appendix C.

12. Over the next several weeks following December 20, 2001, I received feedback from Mr. Chou and his co-inventor regarding the patent application.

15. On or about February 11, 2002, I filed the Subject Application with the US Patent and Trademark office.

16. Based upon the foregoing facts, on information and belief, the Claimed Invention was conceived by the inventors of the Subject Application before December 21, 2001.

17. The inventors, Mr. Aronoff and I were diligent, from conception of the Claimed Invention, up through constructive reduction to practice of the Claimed Invention, by filing the Subject Application on February 11, 2002 with the US Patent and Trademark Office.

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DECLARATION

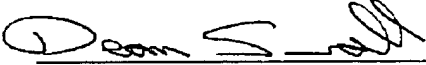
As the person signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application and any patent issued thereon.

SIGNATURE

SOLE INVENTOR

Full Name: Dean D. Small

Signature: Date: 6/30/06Residence: 611 Olive Street, Suite 1611, St. Louis, Missouri 63101

Citizenship: US

Post Office Address: 611 Olive Street, Suite 1611, St. Louis, Missouri 63101The following are attached and made a part hereof:

Attachment A: Preliminary Invention Disclosure dated June 27, 2001, with attached drawings of various embodiments of the Claimed Invention dated June 28, 2001.

Attachment B October 29, 2001 letter from Michael Aronoff to Dean Small, requesting preparation of a patent application.

Attachment C: December 20, 2001 letter from Michael Aronoff to George Jyh-Shann Chou, first named inventor, forwarding first draft patent application to inventors for review.

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APPENDIX A

| | | |
|--|--|--|
| TWC 3 (12/95) PRELIMINARY INVENTION DISCLOSURE | | The Whitaker Corporation (MS 324-001) 4550 New Linden Road, Suite 450 Wilmington, DE 19808 |
| DESCRIPTIVE TITLE OF INVENTION Apparatus for Heat Treating of Micro Contact Components | | DATE 28 Jun 01 |
| WHAT IS THE PROBLEM WITH THE STATE OF THE ART, OR PRIOR ART TECHNOLOGY? WHAT IS THE PURPOSE OF THE INVENTION? Conventional heat treating in the oven is a very time consuming process and imposes some limitations in using low temperature resistant materials as micro contact component's substrates. The invention provides ways to reduce the heat treatment time and lifts the limitations encountered in the conventional heat treatment (see attachment). | | |
| WHAT ARE THE NEW FEATURES OF THE INVENTION WHICH OVERCOME THIS PROBLEM? Same as above. | | |
| ON SEPARATE DRAWINGS OR SKETCHES, DESCRIBE THE FEATURES OF THE INVENTION AND HOW THEY WORK. ARE THESE ENCLOSED? | | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
| IDENTIFY THE CLOSEST PRIOR ART TECHNOLOGY, IF ANY, OF WHICH YOU ARE AWARE. PROVIDE COPIES IF AVAILABLE. N/A | | |
| ENTER THE DATE OF THE FIRST WRITTEN DESCRIPTION OR THE FIRST DATED SKETCH OF INVENTION AND ATTACH COPIES. | | 29 Jan 01 |
| ENTER THE DATE A WORKING MODEL, DEVICE, OR PROCESS WAS OR WILL BE COMPLETED. | | 08 Feb 01 |
| GIVE A BRIEF DESCRIPTION OF CIRCUMSTANCES OF INITIAL DISCLOSURE OUTSIDE AMP COMPANIES. Concept was delivered to FormFactor Inc. people (covered under CDA) in a meeting on May 10, 2000 (see attached). | | |
| ARE LATEST DRAWINGS ENCLOSED? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO | | ARE THEY CAD? <input type="checkbox"/> YES <input type="checkbox"/> NO |
| IF CAD, WHO SHOULD BE CONTACTED TO RETRIEVE CAD FILES? | | |
| INVENTOR'S FULL NAME (incl. full middle name) George Jyh-Shann Chou | INVENTOR'S FULL NAME (incl. full middle name) Bogdan Octav Ciocirlan | INVENTOR'S FULL NAME (incl. full middle name) |
| BUSINESS PHONE 717-986-5108 | BUSINESS PHONE 717-986-7588 | BUSINESS PHONE |
| FAX 717-986-7070 | FAX 717-986-7070 | FAX |
| AMP EMPLOYEE NO. 50285 | AMP EMPLOYEE NO. 50852 | AMP EMPLOYEE NO. |
| DIVISION Technology (Materials Engineering and Research) | DIVISION Technology (Product and Process Innovation) | DIVISION |
| MAILSTOP 140-10 | MAILSTOP 140-10 | MAILSTOP |
| CITIZENSHIP United States. | CITIZENSHIP Romanian | CITIZENSHIP |
| HOME ADDRESS 5365 Joshua Drive Mechanicsburg, PA 17050 | HOME ADDRESS 26 Woodmere Bldg. Middletown, PA 17057 | HOME ADDRESS |
| SIGNATURE <i>George Chou</i> | SIGNATURE <i>Bogdan Ciocirlan</i> | SIGNATURE |
| DATE 6-29-01 | DATE 06-29-01 | DATE |
| WITNESS <i>Michael J. Perko</i> | WITNESS | WITNESS |
| WITNESS <i>R. J. Perko</i> | WITNESS | WITNESS |
| DIVISION MGR NAME & PHONE Richard J. Perko 717-985-2245 | DIVISION MGR NAME & PHONE Richard J. Perko 717-985-2245 | DIVISION MGR NAME & PHONE |
| — FOR THE WHITAKER CORPORATION USE ONLY — | | |
| THE WHITAKER CORPORATION JUL 09 2001 | | PID NO. 2001153 |
| MSB: _____ | | ATTORNEY <i>Michael J. Aronoff</i> PHONE: (302) 50-361-5979 |

ATTACHMENT TO PID: APPARATUS FOR HEAT TREATING OF MICRO CONTACT COMPONENTS

Electroplating of metallic materials is one step in the fabrication process of micro contact components. Typically, a micro contact component is composed of metallic micro contacts and a substrate that is made of either polymeric or ceramic material. However, high residual stresses due to plating and the as-plated microstructure of the contact body result in inferior stress-relaxation properties. Thus, a heat treatment process is usually considered to improve the stress-relaxation properties of the micro contacts after electroplating. The improvement consists of relieving of the residual stresses and changing the microstructure from as-plated to equi-axis grains by recrystallization. It is believed that the best way to achieve the above changes is to heat treat the metallic micro contacts at high temperatures. Due to the temperature limitations of the micro contact substrate, in order to avoid any damage, the components can be exposed only to a "low temperature treatment" for a long time in an isothermal oven. However, the polymeric materials that can survive the "low temperature treatment" are still considered as high temperature resistant polymeric materials. The choices of these materials are limited and their cost is high.

The invention proposed herein is an apparatus based on the induction heating principle designed to heat treat the metallic micro contacts at high temperatures. During the induction heat treating, the metallic contacts are heated up to high temperatures as an effect of the induced eddy current. The polymeric or ceramic substrate is immune to the induction heating and the substrate is heated up only by the heat transferred from the micro contacts. The substrate temperature is much lower than the temperature limits of the substrate materials. Thus, the limitation imposed by the conventional oven heat treatment to consider only high temperature resistant materials as substrates is lifted and, thus, both low and high temperature resistant materials can be used. Another feature of the proposed apparatus is the reduction of the heat treatment time required to obtain the desired results in terms of stress-relaxation properties. This is due to the exposure of the micro contacts at high temperature. Also, a desired microstructure gradient-like property along micro contact body can be obtained (Figure 1). To emphasize the performances of the heat treating apparatus, a comparison of the stress relaxation test data of micro contacts for three conditions, namely as-plated, heat-treated in the conventional oven and heat-treated by using the proposed apparatus is shown in Figures 2(a), (b), and (c), respectively. Comparable and better stress relaxation properties were found for the inductively heat-treated micro contacts compared to the heat-treated in the oven.

The heat treating apparatus is composed of an induction heating work cell, a component holding stage, alignment fixtures and a stage motion control and mechanism. The motion of the stage relative to the coil of the induction heating work cell can be programmed to fit any profile, such as constant speed, linear speed, index, and/or combination, etc. A sketch of the apparatus is shown in Figure 3. The micro contact components are placed on the Z-adjustable stage (1) and passed through the time varying magnetic field generated and shaped by the coil (2). The adjustable stage (1) is mounted on the XY linear stepper motor (3). The coil (2) is aligned with the adjustable stage (1) by the alignment bridge (4). The coil (2) is mounted to the electrical terminals of the 1kW power supply (5). The frequency of the magnetic field that is generated by the coil (2) is in the range of 10-15 MHz required to effectively provide current penetration

needed for heating the micro contact work piece (the micro contact size is, for example, 0.1 mm in diameter and 1.0 mm in length).

To control the temperature field within the micro contact body, the following process variables were considered:

- Magnetic field intensity, controlled by the power supply.
- Magnetic field frequency, adjusted according to the dimensions of the micro contact.
- Standoff distance (distance between coil and micro contact), controlled by the Z-adjustable stage (1).
- Processing time, controlled by the power supply (5) and XY linear stepper motor (3).
- Convective cooling
- Part geometry

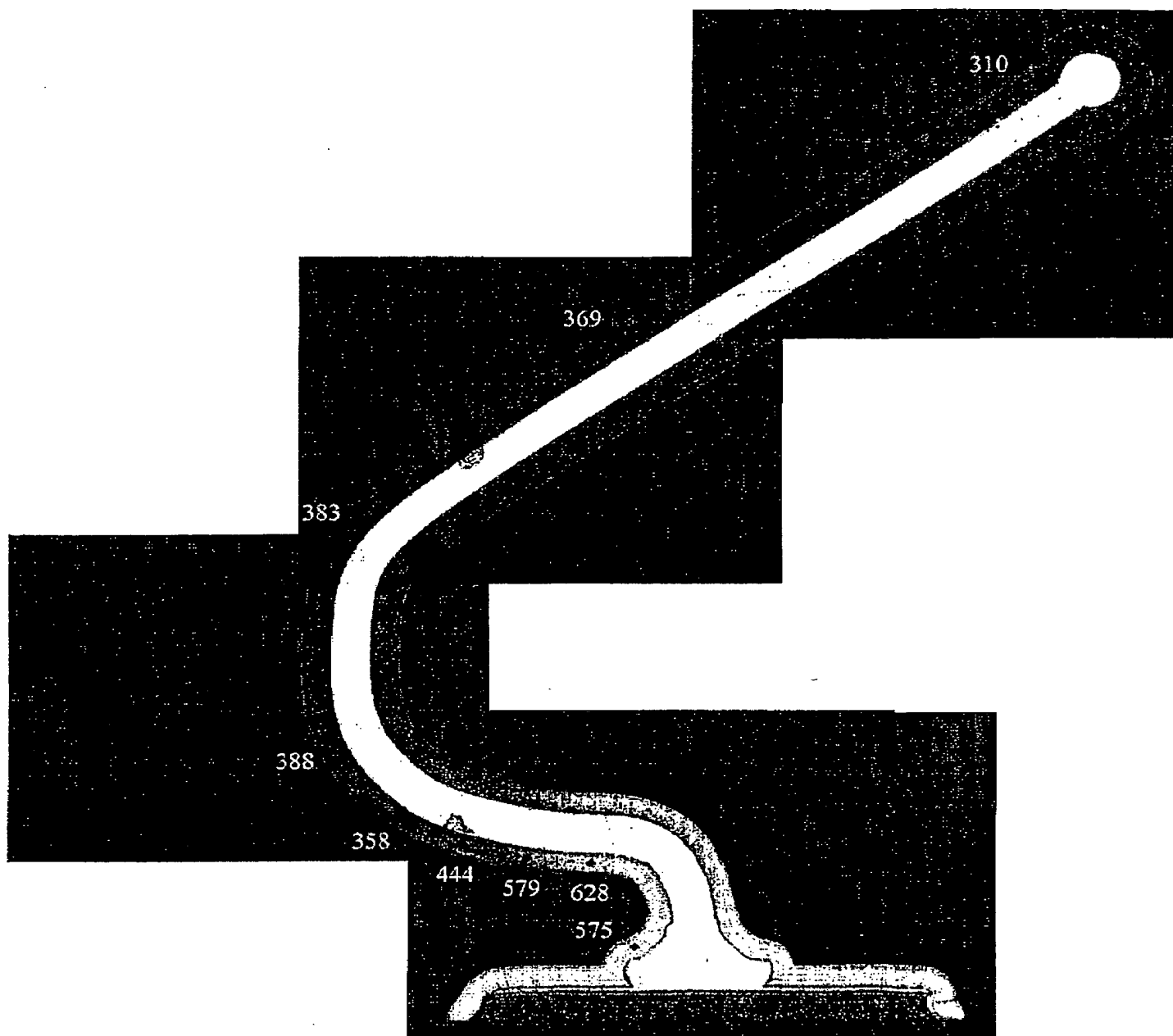


Figure 1. Property gradient in terms of Vicker microhardness number along inductively heat-treated micro contact.

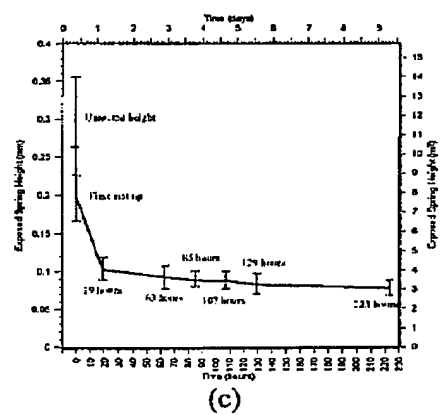
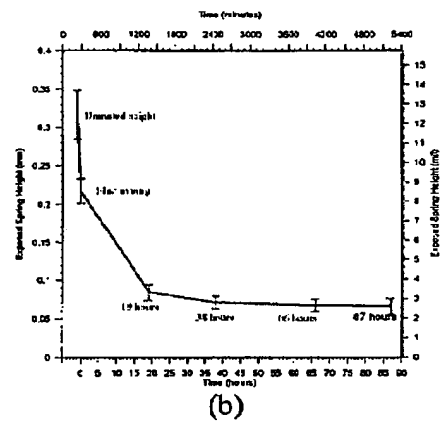
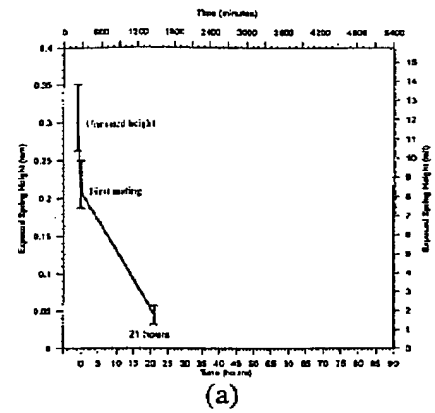


Figure 2. Comparison of stress relaxation data of (a) as-plated, (b) oven heat-treated, and (c) proposed apparatus heat-treated components.

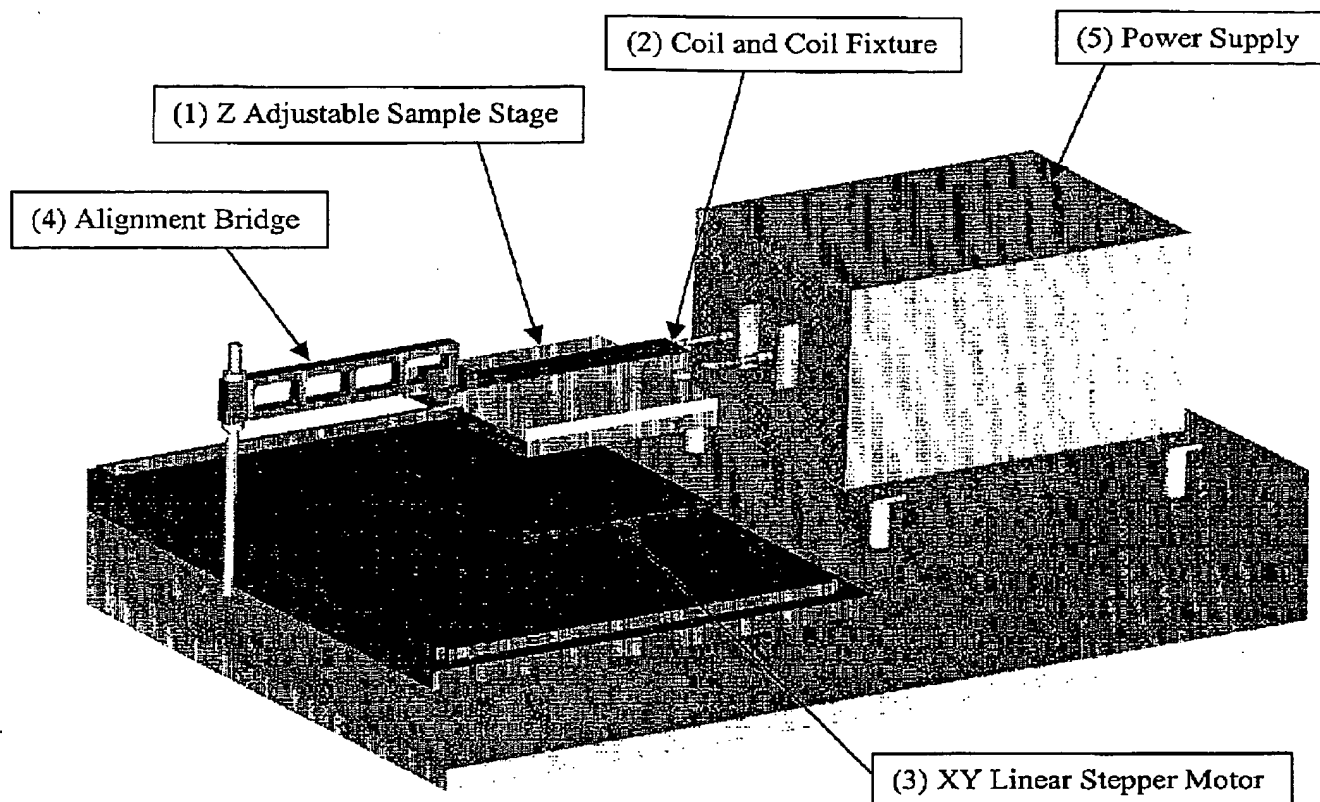


Figure 3. Sketch of the apparatus for heat treating of micro contact components.

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APPENDIX B



Intellectual Property Law Department
Telephone (650) 361-5979
Fax (650) 361-5623

Tyco Electronics Corporation
307 Constitution Drive, MS R20/2B
Menlo Park, CA 94025-1164

mjaronoff@tycoelectronics.com
www.tycoelectronics.com

October 29, 2001

VIA OVERNIGHT MAIL
(312) 775-8198

Mr. Dean Small
McAndrews, Held & Malloy, Ltd.
34th Floor
500 West Madison Street
Chicago, IL 60661

RE: New Patent Application for Apparatus for Heat Treating
Micro-contact Components
Your File No.:
Our File No.: 17714

Dear Dean:

Further to our conversation today, I am enclosing a preliminary invention disclosure form and accompanying documentation for this new technology. Please review the materials and contact George Chou to discuss the details of the novel subject matter. Once you have fully discussed the technology with George, please prepare an application.

One aspect of the invention lies in the use of induction heating to heat a contact that is attached to ceramic substrate. Another aspect of the invention lies in the method of heating the contact. Yet another aspect of the invention lies in the apparatus for performing the heat treatment.

I would like to have an opportunity to review the application prior to filing. If you have any questions or need any additional information, do not hesitate to contact me. I look forward to working with you on this matter.

Very truly yours,

A handwritten signature in black ink that reads "Michael Aronoff". The signature is fluid and cursive, with the first name "Michael" and last name "Aronoff" clearly distinguishable.

Michael Aronoff
Intellectual Property Counsel

Enclosures as stated

This communication contains attorney-client privileged and confidential information and is intended only for the use of the individual or entity named above. If you have received this communication in error, please notify us immediately by telephone and return the original message to us at the address listed above. We will reimburse for postage on all such returned messages. Thank you.

B

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APPENDIX C

McANDREWS, HELD & MALLOTT, LTD.

34th Floor
500 West Madison Street
Chicago, Illinois 60661
Telephone: (312) 775-8000
Facsimile: (312) 775-8100

Dean D. Small
Direct Dial: (312) 775-8198
Dsmall@mhmlaw.com

December 20, 2001

VIA ELECTRONIC MAIL

George Chou
Tyco Electronics
MS 140-10
2901 Fulling Mill Road
Middletown, PA

**Your File No. 17714
Our File No. 13417US01**

Re: U.S. Patent Application
Title: "Method and Apparatus For Induction Heat Treating Electrical Contacts"

Dear George:

At the instruction of our client, Tyco Electronics Corporation (The Whitaker Corporation), we have prepared the enclosed draft patent application, including a set of claims, an abstract, a specification, and informal drawings. Please review these materials carefully, both to supplement areas where more description is needed and to correct any errors. If you are not the sole inventor, please distribute copies of the enclosed materials to your co-inventors and ask that they review the material in the same manner as outlined above. Then return a copy of the application containing your comments so that we may make the necessary changes. Once we have made any necessary corrections and additions to the application, we will send you the application in final form with the necessary paperwork for execution and filing.

As we understand it, all of the rights to the invention described in this patent application shall be assigned (i.e. ownership of all rights in the invention will be transferred) to Tyco Electronics Corporation, 2901 Fulling Mill Road, Middletown, PA 17057.

If you plan to disclose the invention for the first time soon, please advise us of your plans well in advance. If possible, we will complete and file this application before the invention is first disclosed, to preserve your right to file foreign counterpart applications in the future.

Finally, a duty of disclosure rests upon each inventor, each attorney, and every other individual who is substantively involved in the preparation and prosecution of a patent application.

C

M. ANDREWS, HELD & MALLOY, L.L.D.

George Chou
December 20, 2001
Page 2

Each of these individuals has a duty to disclose all material information of which he or she is aware to the Patent and Trademark Office in a timely manner, failing which any resulting patent might be found invalid.

Generally speaking, "material information" is any information which establishes, alone or in combination with other information, a "prima facie" case that the claimed invention is not patentable, or which refutes or is inconsistent with an argument the applicant makes to the PTO respecting patentability. Such "material information" may include:

- 1) disclosures in prior U. S. or foreign patents, patent applications, or publications;
- 2) information known or used by others in this country;
- 3) the details of articles or processes which have been publicly or commercially used, offered for sale or sold in this country by you or others; and
- 4) the prior inventions of other inventors.

Please provide any such information you have which is not already discussed in the enclosed patent application.

If you have any questions, do not hesitate to call.

Very truly yours,

Dean D. Small

Dean D. Small

Enclosures

cc: Michael Aronoff